Feb. 9, 1965 K. WEISWURM 3,169,102

ZERO "G" DISTILLATION UNIT

Filed Feb. 11, 1963 2 Sheets-Sheet 1

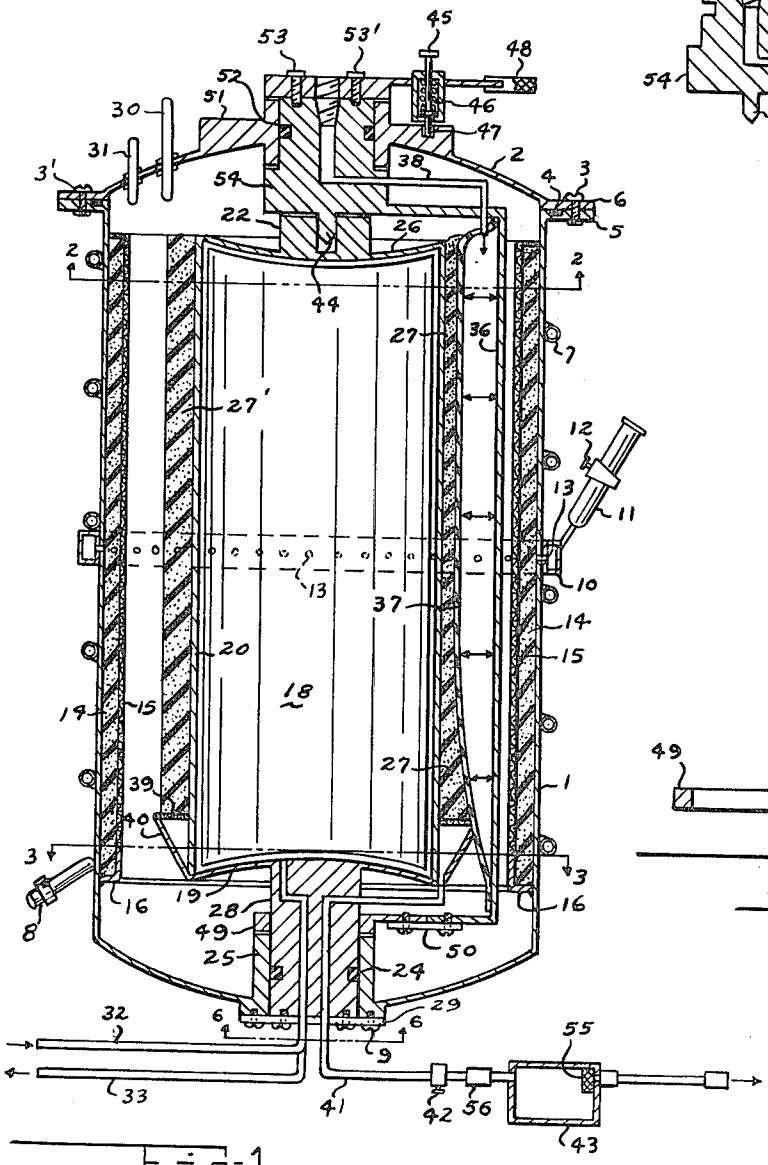

Fig-1

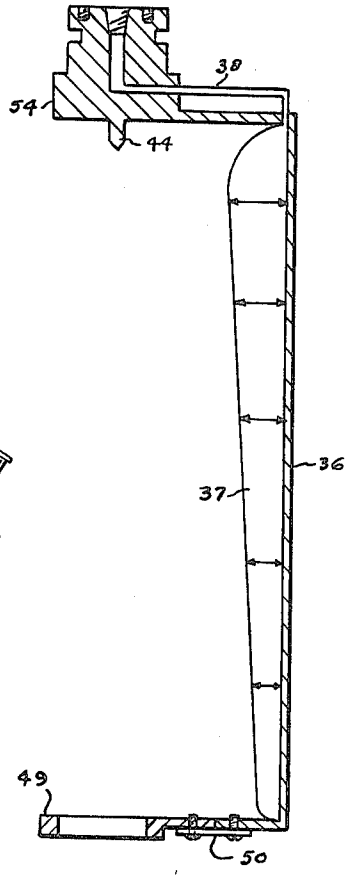

Fig-4

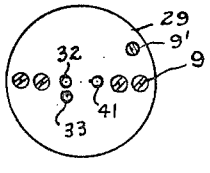

Fig-6

INVENTOR.
KONRAD WEISWURM
BY Wade Coontz
Orlando M. Mackey
ATTORNEYS

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ZERO "G" DISTILLATION UNIT

Filed Feb. 11, 1963 2 Sheets-Sheet 2

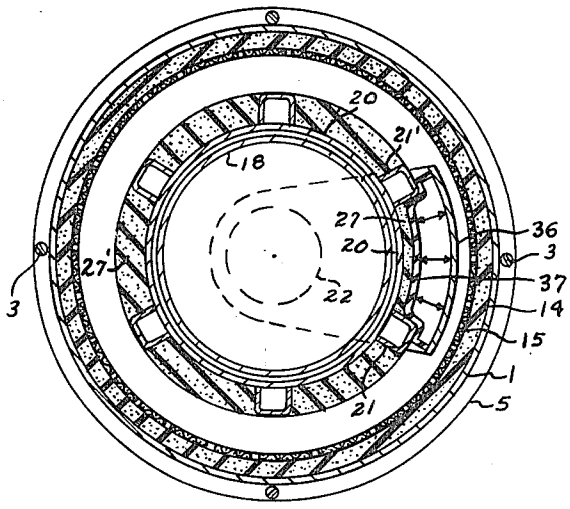

Fig-2

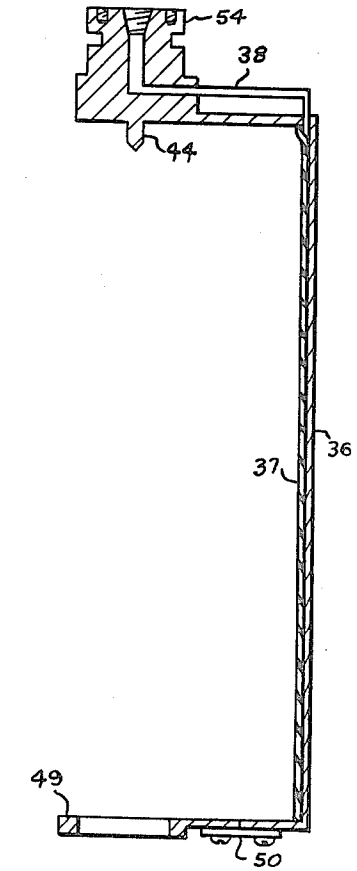

Fig-5

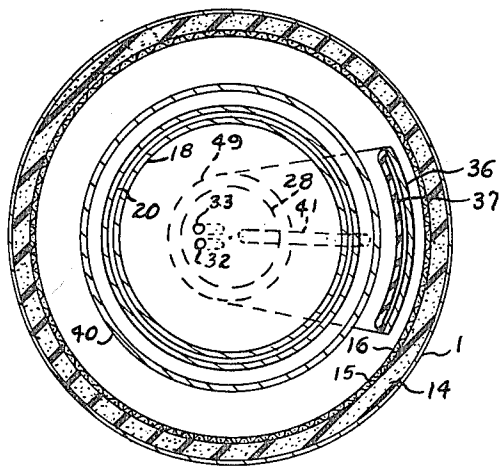

Fig-3

INVENTOR.
KONRAD WEISWURM
BY Wade Brooks and Orlando F. McKay
ATTORNEYS

United States Patent Office

3,169,102
Patented Feb. 9, 1965

3,169,102

ZERO "G" DISTILLATION UNIT

Konrad Weiswurm, 313 Canova Lane, Dayton, Ohio

Filed Feb. 11, 1963, Ser. No. 257,802
3 Claims. (Cl. 202—64)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the United States Government for governmental purposes without payment to me of any royalty thereon.

This invention concerns a water distillation apparatus and method for use under both gravity and nongravity conditions.

The control and processing of liquids in the absence of the force of gravity makes it necessary to adapt containers to controlled, continuously confined disposition of the fluids and liquids as they are being processed. One of the problems encountered in the confinement of human beings in enclosures of limited dimensions is the bulk and the necessity for an adequate supply of water during extended periods of time. The human anatomy requires about 1 to 1½ liters or quarts of water during each 24 hours of time to maintain normal human functions.

The object of the present invention is to use the physical and the chemical properties and characteristics of water and of sponge rubber in accomplishing an adequate supply of water for humans confined in a wholly enclosed environment.

The distillation unit that embodies the present invention is illustrated in the accompanying drawings wherein:

FIG. 1 is a sectional view in elevation of a retort and the condensing equipment that embody the present invention;

FIG. 2 is a sectional view taken along the line 2—2 of FIG. 1;

FIG. 3 is a sectional view taken along the line 3—3 of FIG. 1;

FIG. 4 is an elevational sectional view that is partly diagrammatic, of an inflatable mechanism removed from the device in FIG. 1, and indicated to be in its distended state;

FIG. 5 is an elevational sectional view of the device in FIG. 4 in its collapsed state; and

FIG. 6 is a plan view from the line 6—6 of FIG. 1.

The device that is shown in FIG. 1 of the drawings comprises a hollow stainless steel outer or first cylinder 1 that is closed from above by a header, a top or a lid 2 by a plurality of screws 3, 3', etc. The junction is sealed by a rubber O ring 4 that is positioned between opposed faces of the flanges 5 and 6 of the cylinder and the lid, respectively. A spiral pipe 7 is positioned around the outside of the first cylinder 1 to maintain the cylinder at a predetermined temperature by air or other fluid that is passed through the pipe from a foot or hand operated pump, not shown, that is disposed outside of the assembly and attached therewith through the pipe connection 8.

Midway between the ends of the first cylinder 1 is a hollow manifold 10 that is welded to the surface of the cylinder in sealed relation therewith. The interior of the manifold 10 is connected to the outside of the apparatus through a funnel 11 that is provided with a valve 12. The interior of the manifold 10 is connected to the inside of the first cylinder 1 through a desired plurality of apertures 13.

The inside lateral surface of the first cylinder 1 is contacted by a layer of first sponge rubber 14 that is held thereagainst by a stainless steel wire mesh 15 with its axial edges screwed to the inner surface of the first cylinder 1, such that the sponge rubber 14 may be replaced.

The measured quantity of crude or raw water that is

fed into the funnel 11 is just that absorbed and retained by the sponge rubber 14 by the surface tension of the water and the capillary action of the sponge rubber, to avoid the contamination of the end product. A stainless steel ring 16 of L-section preferably is disposed at the axially lower end of the wire mesh 15 by having its radially outer edge welded continuously along its periphery to the inner surface of the outer cylinder 1.

The interior of the first cylinder 1, sealed by the lid 2, is a closed system and, hence, water vapor that passes through the interstices of the wire mesh 15 is confined within the device.

The second or inner cylinder 20 is mounted coaxially with and inside of the first cylinder 1. The second or inner cylinder 20 is interrupted along its periphery by a desired plurality of axially extending posts 21, 21', etc., such as the six posts that are shown in FIG. 2. The posts project radially of the assembly.

The lower end of the inner cylinder 20 is supported from below by a plate 19 with a pivot 28 at its center. The plate 19 is welded to the lower end of the tank 20. The lower end of the tank 20 and the plate 19 are concave from below to prevent distention from pressure inside the tank 20. The pivot 28 is sealed by the O ring 24 in a bearing ring 25. The bearing ring 25 is welded to the bottom of the outer cylinder 1. The bottom end of the cylinder 1 is concave from above to successfully withstand pressure gradients to which the apparatus is exposed to in use. A locating plate 29 is secured by unsymmetrically mounting screws 9, 9', etc., to avoid misassembly, on the bottom ends of the bearing ring 25 and of the pivot 28.

The upper end of the inner cylinder 20 is closed by a sheet metal top 26 that is concave from above, after a space occupying closed cylinder 18 is installed inside of the cylinder 20, with spacers, not shown, therebetween. A pivoting boss 22 is at the center of the cylinder top 26. The boss 22 serves as a pivot for a pin 44 that extends downwardly from an upper shaft 54 part of a plate 36 to which is attached a distilled water extracting inflatable rubber bag.

The plate 36 upper shaft 54 is journalled in a bearing 51 with an O ring 52 sealing the junction. The bearing 51 is positioned centrally of and is part of the header or lid 2.

The distilled water extraction plate 36 has a laterally extending lower arm that terminates away from the plate 36 in a ring portion 49 that is journalled for rotation on the pivot 28 and is supported by the upper edge of the ring 25. A strap 50 permits the disassembly of the lower arm of the plate 36, when desired.

A second sponge rubber section 27, 27', etc., is cemented to the radially outer face of each axially extending arc of the inner cylinder 20 between each pair of axially extending posts 21, 21', etc.

The temperature gradient between the second sponge rubber sections 27, 27', etc., and the cylindrical first sponge rubber 14 is such that water vapor that passes through the meshes of the wire mesh 15, is condensed to its liquid state in the second sponge rubber sections. The resultant distillate water is retained within the interstices of the sponge rubber sections 27, 27', etc. This balanced relation is indicated by a temperature reading instrument 30 and a pressure reading instrument 31 that are shown mounted on the outer cylinder lid 2. The temperature of the sponge sections 27, 27', etc., below the dew point of water causes distillate water to be absorbed by the second cool sponge.

The low temperature of the sponge rubber sections 27, 27', etc., is maintained by a cooling medium that flows through the pair of pipes 32 and 33 into and out of the inner cylinder 20, around the third cylinder 18. There is

illustratively about ¼-inch clearance between the cylinders 20 and 18. The cooled sponge rubber sections 27, 27', etc., become saturated with the pure water distillate that results from the condensation in the cool rubber of the water vapor in the closed system.

Each section occupied by the sponge rubber 27, 27', etc., between pairs of the posts 21, 21', etc., is successively occupied for distillate water extraction purposes by an axially extending stainless steel distilled water extraction plate 36 with an inflatable rubber bag 37 mounted on its radially inner face. The rubber bag 37 is inflated and deflated through the pipe 38 from outside of the assembly, by a hand or a foot operated air pump, or the like, not shown. The successive occupation of sections of the device by the rubber bag 37 is accomplished by the operation of a handle 48 that has its attached end secured by screws 53, 53' to the top of the shaft 54.

The rubber bladder or bag 37 is designed to distend in an axially graduated manner to advance the distillate water ahead of it from the top to the bottom of each sponge rubber section 27, such as by the contour of the bag 37, by having thinner rubber at the top than at the bottom of the bag, or the like. The purpose of the graduated distention of the bag 37 is to press the distillate water out of each sponge rubber section ahead of the bag distention from the top to the bottom of each section.

The distillate water product flows from the sponge rubber sections 27, 27', etc., through a screen 39 into the gutter 40 and from the gutter 40 through the pipe 41, past the valve 42 and into the distillate water tank or reservoir 43. The distillate water may be withdrawn at will from the tank 43 by partial pressure applied to the closed system as by suction applied by operation of a hand pump or a foot pump, not shown. The same pump is used initially to establish the pressure differential in lowering the pressure within the closed system to below the vapor pressure of the raw water that is caused to saturate the radially outermost sponge rubber 14. The sponge rubber 14 is illustratively ½-inch thick whereas the sponge rubber section 27 is ¾-inch thick to provide about equal storage capacities. The screen 39 keeps the sponge rubber 27 up out of the trough 40 to minimize water loss by capillary attraction. The screen 39 may be replaced by another type of flap valve if preferred.

The draining of the distillate water from each sponge rubber section 27 is followed by the deflation of the rubber bladder 37 as is indicated in FIG. 5, such as by a low pressure applied through the pipe 38 or the like. The operator then lifts with one hand the section space registering pin 45 against the yielding resistance of its spring 46 up out of its section aperture 47, while with the other hand he grasps the handle 48 and rotates the deflated bladder assembly until the registering pin 45 seats into another section aperture 47' and the process is repeated to press another charge of distillate water into the tank or reservoir 43. Distillate water from the tank 43 is processed further as preferred.

The filter 55 is a ceramic filter that prevents water from passing through the filter and outside of the tank 43, when a pump is connected thereto in lowering the pressure in the tank 43.

The removal of water from the tank 43 for its further purification and use, is accomplished by closing the valve 42 and opening the line or pipe connection 56. The tank 43 is then pressurized through the filter 55 in emptying the tank into another container, not shown. The empty tank 43 is again connected with the system by reattaching the line connection 56. Negative pressure then connected to the tank 43 and with the valve 42 again opened permits the lowering of the vapor pressure within the closed system to a needed value indicated by the pressure indicator 31 at the temperature indicated by the thermometer 30 to again start the system in operation.

It is to be understood that the device and its operation that are disclosed herein are submitted as describing a successfully operating embodiment of the present invention and that similarly operating modifications may be made therein without departing from the spirit and scope of the present invention.

I claim:

1. A water distillation device that comprises a downwardly closed hollow stainless steel first outer cylinder; a lid removably secured to the outer first cylinder for closing the interior of the first cylinder to its environment as a closed system; a spiral pipe positioned around the outside of the first cylinder for controlling the temperature thereof; a hollow manifold welded to the first cylinder between the ends thereof with the interior of the manifold opening into the interior of the first cylinder; a raw water receiving funnel connected from the outside of the device to the inside of the manifold; a first valve releasably sealing the funnel from outside of the device; a first layer of sponge rubber contacting the lateral inner surface of the first cylinder and accessible to the interior of the manifold for the absorption of raw water from the funnel by the first sponge by capillary attraction; a stainless steel wire mesh removably retaining the sponge rubber against the lateral inner surface of the first cylinder; a second cylinder mounted within the first cylinder; a plurality of axially extending posts secured to the radially outer surface of the second cylinder and extending axially thereof; a distillate water absorbing second sponge rubber section cemented to the radially outer face of each axially extending arc of the second inner cylinder between each pair of posts; an axially extending stainless steel plate shaped transversely as a curved section of a cylinder and positioned between the first and second cylinders and with an inflatable rubber bag that is also within the first outer cylinder and on the radially inner face of the steel plate mounted on its radially inner face to be inflated and deflated from outside the assembly and the rubber bag being adapted to distend in graduated manner to press the distillate water out of the second sponge rubber section ahead of the bag's distention; a distillate water collecting gutter at the terminal inflation axial end of the rubber bag; a pipe leading from the gutter to outside of the assembly; and a distillate water tank outside of the water distillation assembly and valved through the pipe to the gutter.

2. The water distillation apparatus comprising a funnel for receiving raw water, a valve for opening and closing the funnel, a manifold receiving raw water from the funnel when the valve is open, a first cylinder with its interior communicating with the interior of the manifold for receiving raw water therefrom, a raw water receiving replaceable first sponge in communication with the interior of the manifold for absorbing raw water therefrom, means for heating the raw water sponge for vaporizing water therefrom into the interior of the first cylinder, a second cylinder mounted within the first cylinder, a distillate water liquifying second sponge between the interior surface of the first cylinder and the outside of the second cylinder, temperature depressing means lowering the temperature of the second sponge below the dew point of water that is absorbed as distillate water collected by capillary action and retained within the second sponge, means selectively compressing the second sponge for extracting the distillate water therefrom, gutter means receiving distillate water from the second sponge on the compression thereof, and distillate water tank means receiving distillate water from the gutter means on the application of negative pressure to the distillate water tank that is below the vapor pressure between the first and second cylinders.

3. The process of accomplishing the distillation of a liquid having a vapor pressure within a closed system by saturating by capillary action within the closed system a first sponge with the raw liquid, maintaining the first sponge at a temperature at which the liquid passes from

its liquid phase to its vapor phase within the closed system, maintaining a second sponge within the closed system in vapor communication with the first sponge at a temperature at which the vapor from the liquid in the first sponge changes from its vapor phase to its liquid phase, saturating by capillary action the second sponge with the distillate of the liquid from the first sponge, pressing the distillate out of the second sponge into a distillate conducting gutter, and withdrawing the distillate from the gutter by applying a partial pressure to the closed system.

No references cited.

NORMAN YUDKOFF, *Primary Examiner.*

GEORGE D. MITCHELL, *Examiner.*